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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/700,236	05/09/2001	Xiong Zhang	83973/269224	3694

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EXAMINER

SONG, MATTHEW J

ART UNIT

PAPER NUMBER

1765

DATE MAILED: 05/08/2002

9

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/700,236

Applicant(s)

ZHANG ET AL.

Examiner

Matthew J Song

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☐ Claim(s) ____ is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-12 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) ____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Claim Objections

1. Claims 3 and 4 are objected to because of the following informalities: The use of "AB.....AB" is unclear. "AB....AB" has been interpreted by the examiner to mean repeating AB and excludes a single AB structure. Appropriate correction is required.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. The term "related" in claims 1,2 and 12 is a relative term, which renders the claim indefinite. The term "related" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. The term "related" is indefinite because applicant has not disclosed how "related" is limiting in the specification.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1-4 6-8 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohba et al. (US 5,656,832) in view of Tischler et al. (US 5,679,152).

Ohba et al teaches a semiconductor heterojunction device, where an AlN first buffer layer of less than 10 nm (col 6, ln 1-10), where the growth temperature is in the range of 350-800°C (col 6, ln 23-32) and an InN second buffer layer of 50-1000nm is formed on the first buffer layer in a range of 300-1000°C (col 6, ln 48-67 and col 7, ln 1-5) and a GaN layer, with a thickness of 50-1000 nm, is formed thereon at a substrate temperature of 500-800°C. Ohba et al also teaches heating the resultant up to 1050°C and forming a $\text{Ga}_{0.7}\text{In}_{0.3}\text{N}$ layer and a Si-doped n-type $\text{Al}_{0.2}\text{Ga}_{0.45}\text{In}_{0.35}\text{N}$ layer, thereon. (col 7, ln 47-67) It is well known in the art that AlN and InN have a lattice constant and an energy band gap different from each other.

Ohba does not teach a periodic or nonperiodic multi-layered buffer in which the layers alternate.

In a method of forming a single crystal Gallium Nitride type compound, Tischler et al teaches misfit dislocations density can be reduced by buffer layers of a superlattice structure comprising alternating layers A and B, where A and B are selected from GaN, AlN and InN, where the strained superlattice can comprise from 5 to 200 alternating A, B monolayers (col 4, ln 26-50). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Ohba's invention with Tischler's superlattice because it forces dislocations to the edge of the substrate instead of propagating into the growing layer.

Referring to claim 1, the combination of Ohba et al. and Tischler does not teach the layers formed on said substrate are formed by MOCVD. It would have been obvious

to a person of ordinary skill in the art at the time of the invention to modify the combination of Ohba and Tischler by growing said layers using a MOCVD technique because it is well known in art to use MOCVD for preparing semiconductor thin films.

Referring to claim 5, Ohba teaches a GaN layer on top of an InN layer on top of an AlN layer. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Ohba with Tischler's repeating buffer structure because it reduces dislocations in a growing layer.

Referring to claim 8, the combination of Ohba and Tischler does not teach a multi-layered buffer consisting of 3 periods of repeated AB units and the total layer thickness of said multi-layered buffer is approximately 24 nm. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Ohba and Tischler by attempting to optimize same by conducting routine experimentation.

6. Claims 9-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohba et al. (US 5,656,832) in view of Tischler et al. (US 5,679,152) as applied to claim 3 above, and further in view of Edmond et al. (US 5,739,554).

The combination of Ohba and Tischler teach all of limitations of claim 9, except the compound semiconductors, A and B, are made of GaN and $\text{Ga}_x\text{Al}_{1-x}\text{N}$ ($0 \leq x \leq 1$), respectively.

In a method of manufacturing a light emitting diode with a gallium nitride active layer, Edmond et al teaches a first buffer layer of gallium nitride and aluminum nitride and a second layer of gallium nitride and aluminum nitride adjacent to the first. Edmond

also teaches the buffer layer comprises a layer selected from the group consisting of gallium nitride, aluminum nitride, indium nitride and ternary Group III nitrides having the formula of $A_xB_{1-x}N$, where A and B are Group III elements and where x is zero, one or a fraction between zero and one (col 5, ln 40-60). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Ohba and Tischler with Edmond because Edmond teaches an equivalency between AlN and $Ga_xAl_{1-x}N$ for use in buffer layers.

Referring to claim 10 and 11, the combination of Ohba and Tischler teach all of limitations of claim 9, except the compound semiconductors, A and B, are made of GaN and $Ga_xIn_{1-x}N$ ($0 \leq x \leq 1$), respectively. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Ohba and Tischler with Edmond because Edmond teaches an equivalency between AlN and $Ga_xIn_{1-x}N$ for use in buffer layers.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Schetzina (US 5,679,965) teaches a single epitaxial multiplayer structure using growth techniques such as MOCVD or other techniques known to those skilled in the art of preparing semiconductor thin films and device structures (col 12, ln 10-30). Schetzina also teaches the difference in lattice constant and band gap for GaN, AlN, and InN. (table I)

Kim et al. (US 5,697,826) teaches a sub-region includes a plurality of sub-layers a,b,, etc, where the first and each alternate one of the sub-layers has a composition of $\text{Al}_y\text{Ga}_{1-y}\text{N}$ and each alternate sub-layer has a composition of $\text{Al}_z\text{Ga}_{1-z}\text{N}$. (col 7, 1-15)

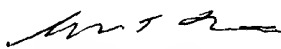
Kaneno et al. (US 5,426,658) teaches a AlGaAs/GaAs superlattice buffer layer grown at 700°C where five, 200 angstroms thick AlGaAs and five, 500 angstroms thick GaAs layers are alternately laminated. Kaneno et al also teaches a n type GaAs current blocking layer grown on the superlattice buffer layer grown with good crystallinity. (col 11, 20-55)

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 703-305-4953.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin L Utech can be reached on 703-308-3868. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

mjs
May 6, 2002


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